

## 7.—Distribution and variation of the skink *Ctenotus labillardieri* (Gray) of southwestern Australia

by Julian Ford \*

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### Abstract

This study of specimens in the Western Australian Museum collection has revealed the present distribution of *Ctenotus labillardieri* (Gray) to be restricted to the higher rainfall regions of South-Western Australia. The suggestion that it is also discontinuously distributed throughout more arid parts of the State has resulted from confusion with *C. lesueurii* (Duméril and Bibron). Geographic variation in several characters is discussed and the species is divided into two subspecies, *lancelini* subsp. nov. on Lancelin Island and the nominate form on the mainland and south coast islands.

### Introduction

The skink *Ctenotus labillardieri* (Gray) inhabits the higher rainfall region of southwestern Australia. An assertion by Glauert (1960, 1961) in his revision of the family Scincidae in Western Australia that it also has a scattered and discontinuous distribution in the north-western and mid-western parts of Western Australia, prompted me to carry out an investigation on its distribution and variation. During this study specimens in the Western Australian Museum were examined including all of the material that was available to Glauert.

All northern records of *labillardieri* are attributable to misidentification of *C. lesueurii* (Duméril and Bibron), a species which is virtually allopatric with *labillardieri*. *C. lesueurii* occurs all over the State except the humid south-west corner although there is some penetration into the Swan coastal plain, the northern Darling Range and the south coast.

Confusion between *labillardieri* and *lesueurii* has arisen from the fact that, although the prefrontals are usually in contact in *lesueurii*, a small number of specimens have them separated as in *labillardieri*. Moreover, a number of these atypical *lesueurii* as well as individuals with normal head scalation resemble *labillardieri* in lacking a black, white-edged vertebral streak. However, *lesueurii* always has three supraoculars in contact with the frontal whereas in *labillardieri*, two are in contact except for a small percentage of south coast specimens which have three in contact.

### Distribution and habitat preference

The range of *C. labillardieri* is the more humid parts of the South-West, north to Lancelin Island, east to Esperance and the Recherche Archipelago, and inland to Mundaring, Boddington, Woodanilling, the Stirling Range and Ravensthorpe. On the Swan coastal plain it is rare, having only been seen on the east side of

Lake Clifton (in damp localities in Tuart, *Eucalyptus gomphocephala*, forest where there is considerable ground litter and fallen timber), and at Perth (Zoology Department, W.A. University). The specimens collected at the University (D. Bradshaw, pers. comm.) may have been transported there. There is possibly a distributional gap between Perth and Lancelin Island, where there exists a morphologically distinct population (Ford, 1963; 1965).

The species has a strong predilection for living under granite and gneiss and is particularly plentiful wherever these rocks are exposed in the Darling Range, Porongorup Range, lower South West corner and the extreme south coast; it is also found under fallen logs in these areas. In the Stirling Range it is fairly common on the higher more humid mountain slopes where slates are exposed.

East of Bremer Bay its distribution is possibly discontinuous and dependent on suitable rocky areas, known localities along this coastal strip including East Mt Barren, Kundip, Ravensthorpe (?), Esperance, Cape Le Grand and the lower Dalyup River. From the Recherche Archipelago it has been collected on Mondrain, Middle, Thomas, Charley and Figure of Eight Islands (Glauert, 1954), while in the vicinity of Albany it occurs on Bald, Michaelmas and Eclipse Islands.

It seems strange that *labillardieri* has not been found north of Mt. Helena in the Darling Range. It is quite abundant to the immediate south of its range limit so its scarcity or absence is doubtless real and probably related to slight changes in the nature of the terrain and climate. My belief is that likely habitats to the north become too dry during the summer since the species seems to prefer damp situations. The significance of the distribution gap between the Lancelin Island population and that on the mainland has been discussed elsewhere (Ford, 1963; 1965).

### Taxonomy

Since the Lancelin Island population of *Ctenotus labillardieri* is clearly separable from all mainland and south coast island populations which may be grouped together, the following ternary nomenclature is proposed:

#### (1) *Ctenotus labillardieri labillardieri* (Gray)

*Tiliqua labillardieri* J. E. Gray, 1839, Ann. Nat. Hist., 2: 289. Australia.

*Lygosoma labillardieri* Duméril and Bibron, 1839, Erpétologie générale 5: 73. Western Australia.

*Hinulia greyii*, J.E. Gray, 1845, Cat. Specimens Liz. Brit. Mus. p. 76 Swan River, Australia.

*Ctenotus labillardieri* Storr, 1964. W. Aust. Nat. 9: 44.

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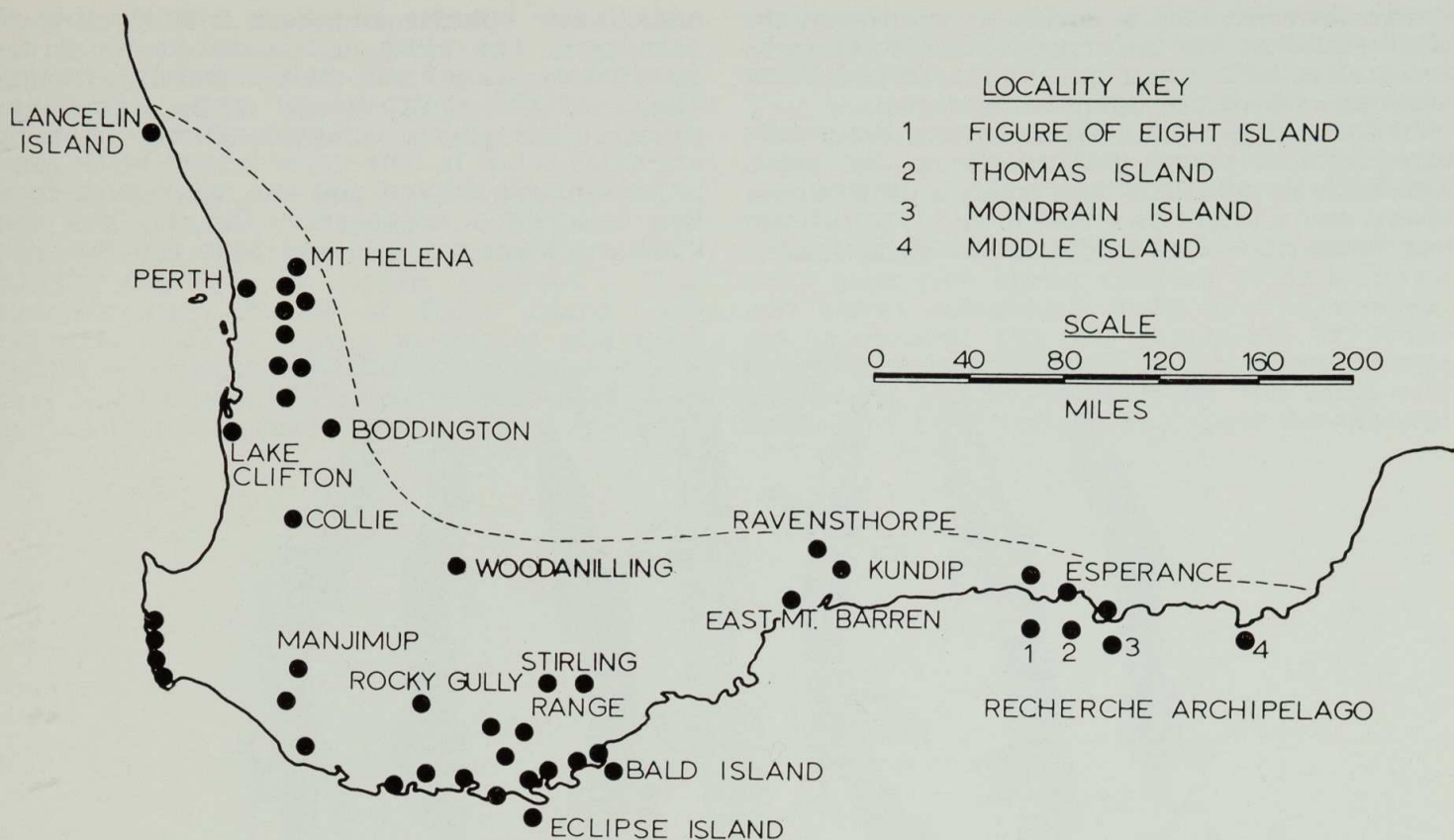


Figure 1—Map of the South-West of Western Australia showing location of specimens of *Ctenotus labillardieri*.

A variable dark form with the dorso-lateral white streaks contrasting sharply with the black streaks on the back and sides.

(2) *Ctenotus labillardieri lanceolini* subsp. nov.

The holotype is R18872 (in the Western Australian Museum) collected by J. Ford on October 7, 1961, on Lancelin Island. The pale brown coloration, dappled appearance on the back, and yellow (instead of reddish brown) on the legs distinguishes this form from the nominate subspecies.

(3) *Ctenotus labillardieri* subsp.

Specimen R18005 collected on December 12, 1959, by G. M. Storr, 11 miles west of Ravenshorpe, may represent a new subspecies or may be an aberrant individual.

It is readily distinguished by its speckled appearance and by the dorso-lateral white lines being reduced to a series of pale dashes. Particulars of the specimen are—head plus body length 50 mm; midbody scales 26; upper labials 7+7; ear lobules 5+4; lamellae under fourth toe 21; ratio hind leg to fore 1.39. There are three supraoculars in contact with the frontal on one side, and two on the other; the interparietal is small and narrow instead of being about the same size as each of the frontoparietals, which in this specimen are of unequal size.

Included in the material identified by Glauert as *C. labillardieri* is an undescribed species represented by specimen R10639 collected at Dumbleyung and which has since been collected at Boyagin (R22516-7). It and *C. labillardieri* can be considered sibling species.

**Geographic variation**

*Coloration*

Although nominate *labillardieri* may be divided into a number of fairly distinct colour types, geographic variation in colour pattern tends to be clinal. There is also a certain amount of individual variation, particularly in south-coast populations.

The population from the northern part of the Darling Range between Boddington and Mt. Helena is characterised by sharply defined markings on the back and sides. The dorsal surface is usually bronze-brown. A narrow white sharp-edged streak starts on the supra-oculars and runs dorso-laterally down to the tail where it becomes less distinct. Bordering on the dorsal side of this is a fine black streak of similar sharpness, and below (starting behind the eye) a broad black streak which is frequently spotted with white and pale brown. This in turn is bounded below by a mid-lateral narrow white streak which commences below the eye and passes through the ear and over the limbs to the tail; it is somewhat ragged-edged compared with the dorso-lateral white streak. Below this is another fairly broad black-brown streak followed by a third ragged-edged white streak starting below the ear aperture and passing almost ventro-laterally through the limbs. The dark markings on the sides below this are of irregular shape and tend to form a narrow ventro-lateral brown streak between the limbs. The under surface is whitish except on the chin and throat where the scales have small brown flecks. Two juvenile specimens from Lake Clifton are identical with Darling Range material

except that the back is silvery grey with minute black flecking; the upper surface of their limbs are orange with small irregularly shaped black markings which are not interconnected.

In the extreme South-West corner, the markings are less sharp, particularly on the sides. The back is not bronzy but varies between olive-brown and a bright pale brown, and it sometimes has faint black flecks. The dorsal black streaks

are slightly broader and have a single row of pale spots. The white mid-lateral streak is almost zigzag-shaped and there is merely a resemblance of the ventro-lateral white streak because of the almost complete absence of dark markings below it. The upper lateral black zone is irregularly spotted and the lower dark area has a speckled appearance. On the legs the black markings are bold and form a network.

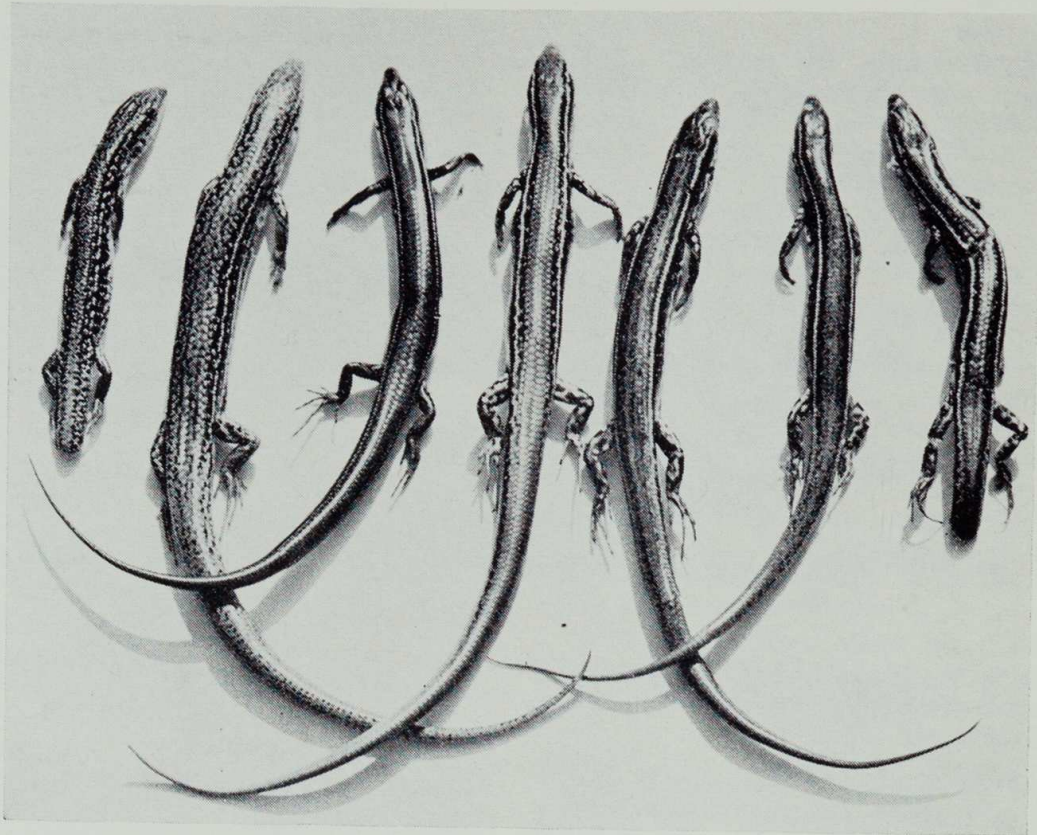


Figure 2—Specimens of *C. labillardieri* from left to right are from Ravensthorpe, Lancelin Island, Mundaring, Northcliffe, Bald Island, Mt. Many Peaks and the lower Dalyup River.

Material from the south end of the Darling Range is intermediate between that from the lower South-West and the north Darling Range area, there being a smooth transition from one form to the other although the gradient appears to be steep.

Along the extreme south coast, between Northcliffe and Mt. Many Peaks, the black and white streaked pattern on the sides remains virtually constant but the amount of black on the dorsal surface appears to increase from west to east, and the black dorsal streaks become broader and more ragged-edged. Both the dorsal and upper lateral black streaks are white spotted as in South-West specimens. There are also blackish dashes on the back which tend to form a line down the centre, and in some cases, two indistinct black lines. This trend is developed further in the populations on Bald and Eclipse Islands where most specimens have a ragged-edged black vertebral streak from the nape to behind the hind limbs so that there is much less brown dorsally.

The Porongorup Range, Mt. Barker and Rocky Gully material is like that from the deep South-

West except that the black streaks are slightly broader and more ragged-edged, and there are longer fine blackish flecks on the back which varies in colour between brown and bright pale brown. The dorso-lateral white streak is slightly ragged. The mid-lateral white streak is zigzag-shaped or disjointed while the brown below is very irregular giving the sides a speckled appearance. Stirling Range material is like that from the Porongorup Range except that the vertebral brown area on the back is broader due to narrower black streaks, while the side pattern is still more speckled in appearance with the black reduced.

East of Bremer Bay the species is possibly split into a number of disconnected populations which has resulted in each being different morphologically. Mostly however, the various populations resemble lizards from Mt. Many Peaks in that the outer dorsal black streaks are broad but differ in being sharper edged. Specimens from the lower Dalyup River, Esperance and Cape Le Grand have this pattern but the material from the last locality does not have any spotting on the outer dorsal black streaks.

The East Mt. Barren specimen has rather narrow outer dorsal black streaks like those from the lower South-West corner, and the vertebral area is silvery brown rather than brown as in other specimens from this coastal strip.

Unfortunately only single specimens are available from Middle, Mondrain, Thomas and Figure of Eight Islands in the Recherche Archipelago, and each is slightly different. The example from Figure of Eight Island (see Glauert, 1954) is similar to Eclipse and Bald Island specimens in having an irregular vertebral black streak and ragged-edged outer dorsal black streaks. The Thomas Island specimen

is practically identical with specimens from Cape Le Grand, while the Middle Island and Mondrain Island specimens are similar to those from the south coast between Albany and Denmark although there is no spotting on the outer dorsal black streaks and there is a tendency towards the formation of a middle streak down the back.

Lancelin Island specimens are very distinctive since their pale brown (instead of dark brown and black) colouration gives them a washed-out appearance. The pale streaks are like those in south coast specimens in not being sharp-edged and are not distinct on the head and behind the hind limb. On the upper dorsolateral

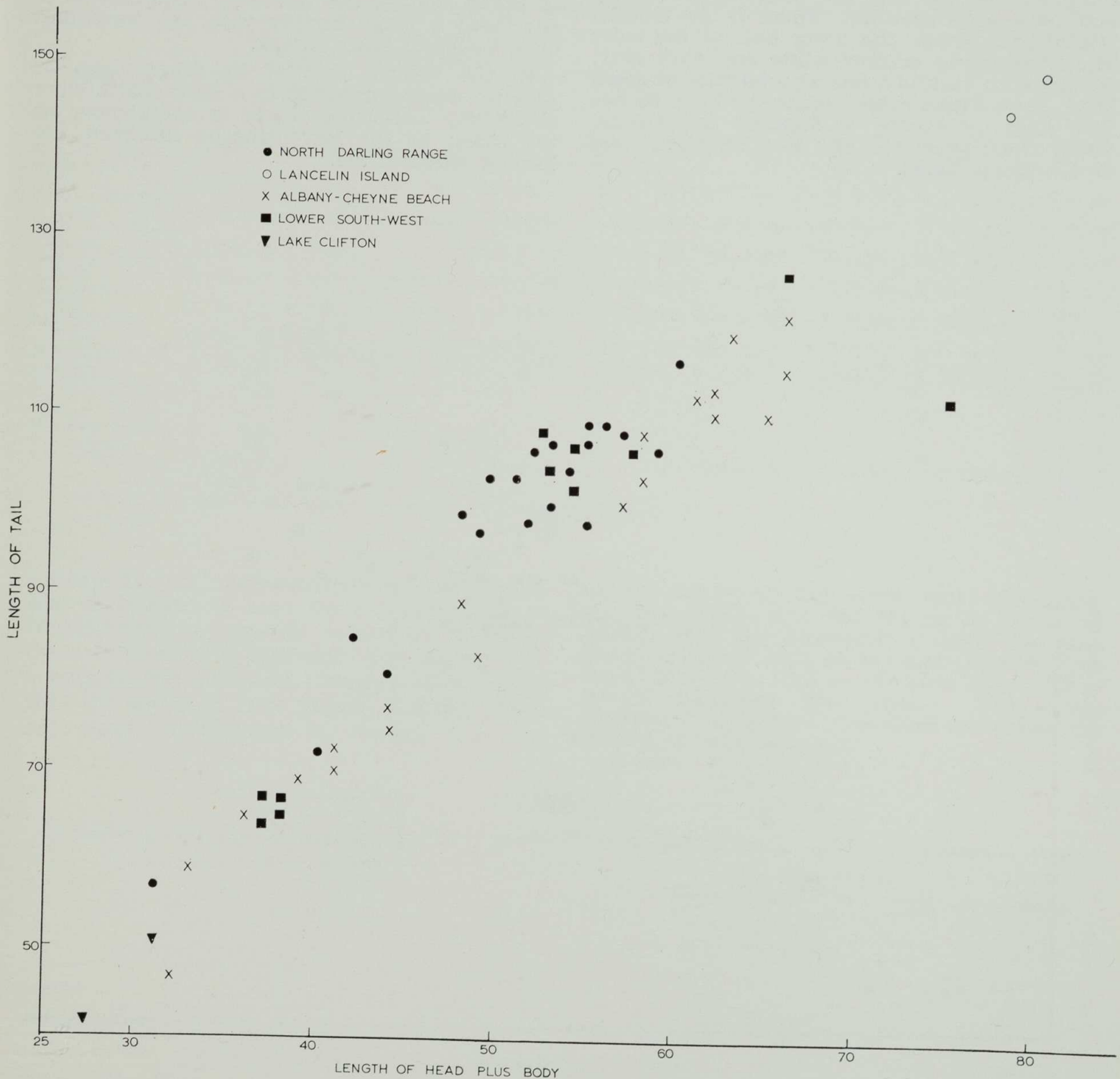


Figure 3—Graph showing relation between length of tail and head plus body of populations of *C. labillardieri*.

dark brown streak there is a series of pale dashes, and the dark areas below are relatively pale and irregularly marked lighter. On the back is a network of dark brown dashes connected with the poorly defined outer dorsal dark brown streaks which are broken up with somewhat enlarged spots. There is only a little flecking on the head and throat. As in mainland populations, the abdomen is a bright yellow during the breeding season. The dark markings on the upper surface of the limbs are also reduced.

The only specimen from Ravensthorpe has a distinct black and grey speckled appearance and does not resemble any other specimen. The dorsolateral white streak is discontinuous, merely consisting of a series of white dashes. The outer dorsal and upper lateral black streaks commence at the eye, are both ragged edged, and have grey spotting. There is no median lateral pale streak, the lower half of the sides being irregularly marked white and dark grey. On the grey back is a liberal peppering of small black spots which extend on to the head as two fine lines producing a stippled appearance. Small black spots are also distributed in rows on the upper limbs.

### Trends in coloration

From the south-west corner northwards there is a definite tendency for the longitudinal streaks to become narrower and sharper, a trend which reaches its peak in the northern part of the Darling Range. The Lancelin Island population does not carry on this cline and constitutes a morphologically distinct isolate. Along the south coast the black dorsal streaks are broader and ragged-edged or spotted.

Between Cape Naturaliste and King George Sound an increase in the amount of black pigmentation on the back appears to be clinal. East of King George Sound the amount of black pigmentation of the back remains more or less constant. On some of the islands along the south coast, including Eclipse, Bald, and Figure of Eight Islands, the trend for melanisation is developed a stage further with the formation of a vertebral black streak.

In the eastern part of its range (east of Albany) there appears to be a south-north cline of slightly increasing degree of speckleness on the sides; in the Ravensthorpe specimen the back is speckled too.

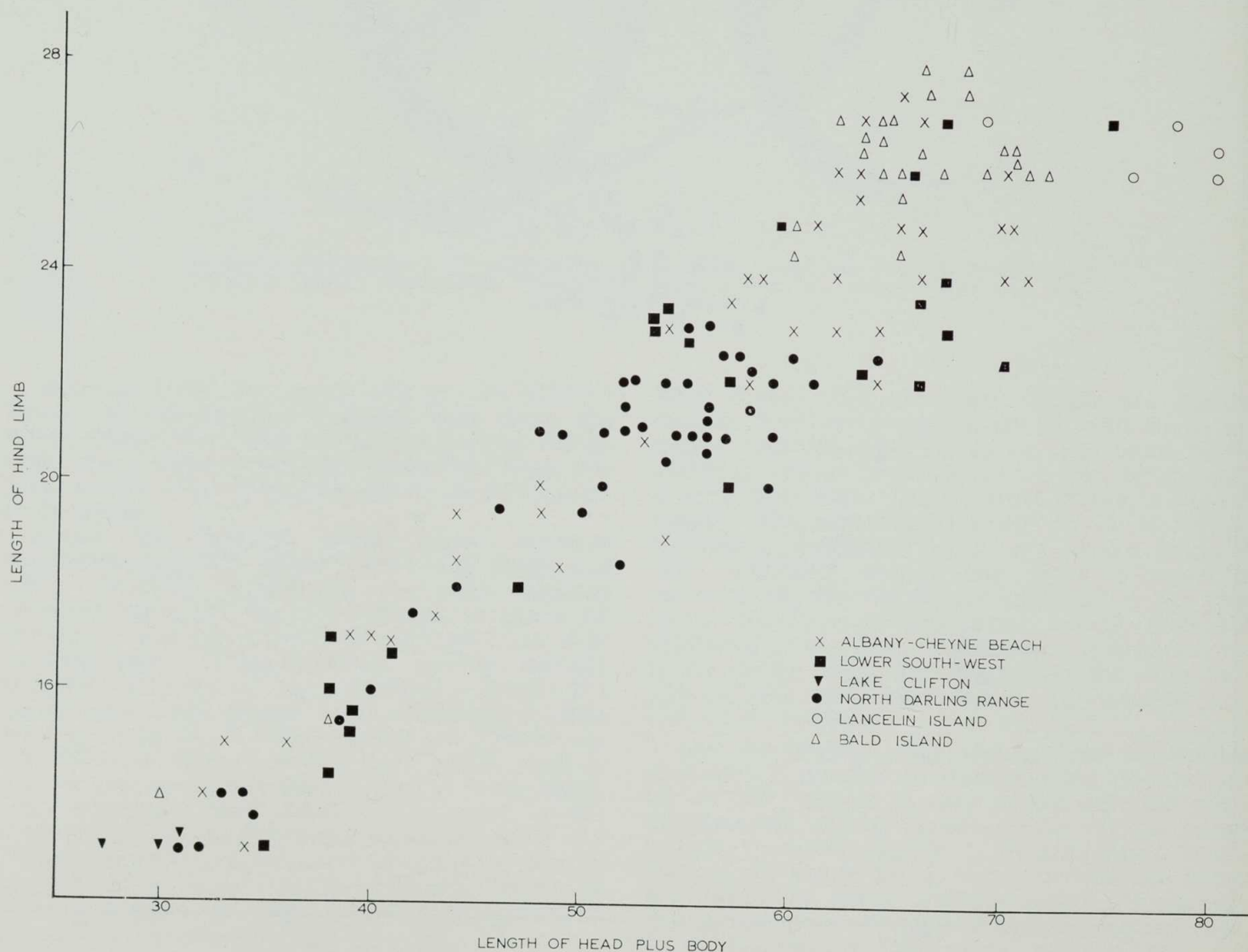


Figure 4—Graph showing relation between the length of the hind leg to the head plus body of populations of *C. labillardieri*.

*Measurements and meristics*

Several clines in measurements and meristics are indicated in Table 1. There appears to be north-south clines of decreasing magnitude of the tail length to head plus body ratio, of decreasing number of mid-body scales, and of decreasing number of upper labials. Similar clines appear to exist in *Egernia pulchra* Werner and *E. bos* Storr (Ford, 1963). These trends in *labillardieri* may possibly exist in an east-west direction but the material from the species' range east of Bremer Bay is insufficient for any definite conclusions to be made. The Bald Island

population has a relatively high mean number of mid-body scales and ear lobules and the data suggest that other island populations on the south coast may share this characteristic. The hind-leg length to fore-leg ratio shows virtually no geographical and, as would be expected for a non-burrowing skink, age variation. Table 1 shows that variation in the hind-leg length to the head plus body ratio is indicated but this is not geographically significant and is associated with allometric growth as illustrated by Figure 4. That allometry is very slight in the growth of the tail with respect to the head plus body can be seen from Figure 3.

TABLE 1

*Mean measurements and meristics of Ctenotus labillardieri, with standard deviations in brackets*

Locality	Sample Size*	Head + Body Length (mm)	Ratio, Tail Length to Head + Body	Ratio, Hind-leg to Head + Body	Mid-body Scales	Upper Labials	Ear Lobules	Lamellae under fourth Toe	Ratio, Hind-leg to Fore-leg
Lancelin Island	5† (2)	76.6 (4.2)	1.86 (0.05)	0.35 (0.03)	24 (0)	8 (0)	3.60 (0.61)	23.00 (0.71)	1.58 (0.03)
Perth-Lake Clifton	3 (2)	29.3 (2.9)	1.62 (0.09)	0.44 (0.03)	25 (0)	7 (0)	3.33 (0.60)	24 (0)	1.59 (0.05)
North Darling Range	44 (20)	51.3 (8.6)	1.94 (0.09)	0.39 (0.02)	25.80 (1.24)	7.61 (0.50)	3.32 (0.68)	23.80 (1.70)	1.53 (0.06)
South Darling Range	4 (0)	60.0 (4.3)	.....	0.39 (0.03)	26.00 (1.63)	7.25 (0.62)	3.75 (0.95)	23.25 (1.70)	1.57 (0.03)
Lower South West	24 (11)	54.3 (4.7)	1.84 (0.10)	0.39 (0.04)	26.46 (1.02)	7.31 (0.49)	3.45 (0.63)	22.84 (1.70)	1.54 (0.09)
Manjimup-Denmark	21 (7)	57.7 (6.0)	1.78 (0.08)	0.40 (0.04)	27.19 (1.34)	7.25 (0.45)	3.60 (0.68)	24.40 (2.39)	1.55 (0.07)
Albany-Cheyne Beach	40 (22)	55.6 (11.8)	1.76 (0.08)	0.40 (0.03)	26.35 (1.13)	7.31 (0.47)	3.73 (0.66)	24.12 (1.84)	1.52 (0.08)
Stirling Range	7 (2)	55.8 (5.3)	2.04 (0.33)	0.37 (0.04)	26.00 (1.00)	7.33 (0.50)	3.63 (0.74)	24.00 (0.94)	1.53 (0.09)
Bald Island	27 (0)	62.4 (4.0)	.....	0.41 (0.02)	29.30 (1.04)	7.41 (0.50)	3.93 (0.62)	24.74 (1.97)	1.54 (0.05)
Eclipse Island	1	53	.....	0.43	30	8	4	23	1.48
Figure of Eight I	1	73	.....	0.39	26	8	4.5	23	1.60
Thomas Island	1	.....	.....	.....	28	8	4	25	1.53
Mondrain Island	2	62	.....	0.45	28	8	4	27	1.60 (0.02)
Middle Island	1	75	.....	0.37	29	8	4	25	1.56
Bremer-Esperance	4 (1)	55.3 (4.5)	1.62	0.40 (0.04)	26	7.80 (0.45)	4.5 (0.58)	22.50 (3.11)	1.55 (1.10)

\* The figure in brackets is the number of specimens with a complete tail.

† All juveniles

About 10% of specimens from the south coast east of Northcliffe have three supraoculars in contact with the frontal instead of two, and there is possibly a west-east cline in the frequency in this character. Glauert (1954) noted that the specimen from Figure of Eight Island has three supraoculars in contact with the

frontal, but in his key (1960, 1961) he ignores this and states that the frontal is always in contact with two supraoculars. Only one Bald Island specimen (out of 24) and three Cheyne Beach specimens (out of 23) have three supraoculars adjoining the frontal. The single Ravensthorpe specimen has three contacting the frontal on only one side.

TABLE 2

*Specimens of C. labillardieri grouped according to number of mid-body scales, upper labials and ear lobules*

Population	Mid-body scales				Upper labials		Ear lobules			
	24-25	26-27	28-29	30-32	7	8	2	3	4	5
Lancelini	5	0	0	0	0	5	0	2	3	0
Mainland northern	19	24	5	0	22	31	4	27	20	1
Mainland southern	24	89	31	0	73	38	1	69	72	10
Bald and Eclipse Islands	0	1	18	13	19	14	0	7	21	4

## Discussion

The study of the adaptive nature of certain geographic trends in the morphology of reptiles has just begun (Mayr, 1963, p. 325). North-south clines and radial clines from the south-west corner in certain bird-species in South-western Australia are correlated with the climatic gradients of temperature and humidity (Ford, in prep.) and this may well be so in several lizard species. In the case of *Ctenotus labillardieri*, *Egernia pulchra* and *Egernia bos*, clines in meristics and body proportions are in the same direction for each species and coincide with the temperature gradient, indicating that physiological factors may be involved.

That at least some of the variation in colour pattern in *C. labillardieri* is an expression of climatic adaptation is indicated by the increased black pigmentation in the south, particularly on several islands along the south coast where the climate is cooler. Kramer (1949) found that lizards on small rocky islands in the Mediterranean tended to be melanistic, the oldest islands among islands of equal size having the blackest forms. The increased melanization, which has a polygenic basis, helps the lizards to warm up during cool seasons and in the morning (Mertens, 1952).

The occurrence of similarly coloured populations on three widely separated south-coast islands (Bald, Eclipse and Figure of Eight), distinct from that on the adjacent mainland, may have arisen in three different ways, viz. (1) parallel evolution resulting from similar selection pressures and adaptation to similar ecological and climatic conditions; (2) the isolation of the remnants of a form which was once distributed on the mainland where it has now disappeared; or (3) the gradient of the north-south cline of increasing melanisation being steeper between the mainland and the islands because of the isolation and concomitant breakdown of gene flow.

The reduction in the amount of dark pigment in *lancelini* is possibly an edaphic adaptation involving cryptic coloration against the substrate as a result of predation by birds (Ford, 1963). It is also possible that the paleness is correlated with the mild climate of this small island where lizards find it less difficult to warm up than their fellows in cooler areas.

The larger size of specimens from Lancelin Island may be due in some way to their belonging to the northernmost population. G. M. Storr (pers. comm.) informs me that at least two other skinks, *Ctenotus lesueurii* and *Sphenomorphus monotropis* (= *richardsoni*), and several *Amphibolurus* species increase in size from south to north. It could be that large size in an adaptation for conserving body water (Schmidt-Nielsen, 1964): with increasing length, relative surface area decreases (and relative evaporative loss).

## Specimens examined

R18871-5 (Lancelin Island); R1978-9 (Mt. Helena); R8850, R21229 (Mundaring); R14858 (Mundaring Weir); R4907-8 (Herne Hill); R19120, R19492-4 (Kalamunda); R4676 (Goose-

berry Hill); R10262-4 (Barton's Mill); R3340-1, R5984-6, R21262 (Darlington); R627 (Glen Forrest); R4965 (Gosnells); R17987-8, R19118 (Karragullen); R17990 (Roleystone); R17981-2 (Churchman's Brook); R19247, R19803 (Byford); R17985-6 (Wongong Brook); R17992-5 (Keysbrook); R17977, R17978-80 (Serpentine Dam); R6768 (Banksia Dale); R10708-10 (Bodington); R17966-8 (Lake Clifton); R19244-6, R17969 (Collie); R17953-5 (Margaret River); R13446 (Karridale); R259, R263, R12783, R17956-65 (Cape Leeuwin); R66 (Mammoth Cave); R19833, R13417 (Boranup); R12426, R12776 (Deepdene); R5578-9, R8184, R19039-40, R17950, R5582 (Manjimup); R5580-1 (Pemberton); R17970-3 (Mt. Chudalup); R11039 (Norralup); R260-1, R264 (Kent River); R19853-4 (Denmark); R17952 (Rocky Gully); R21823 (West Cape Howe); R10946 (Albany); R4251, R4514 (Chorkerup); R18004 (Pardalup); R19117 (Lower Kalgan River); R7732 (Calgardup); R6571 (Woodanilling); R21809-15 (Mt. Toolbrunup, Stirling Range); R21805-8 (Devil's Slide, Porongorup Range); R17872-6 (Mt. Many Peaks); R17926-47, R21819 (Cheyne Beach and lower Waychinicup River); R17877 (Waychinicup River); R11005 (Kundip); R17976 (East Mt. Barren); R17949 (lower Dalyup River); R14948 (Esperance); R17901 (Mondrain Island); R10234 (Thomas Island); R8684 (Middle Island); R22529 (Cape Le Grand); R17903-20, R179021-5, R19972-4 (Bald Island); R11278 (Eclipse Island); R10119 (Figure of Eight Island); R18005 (Ravensthorpe).

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